This paper contributes to an important discussion about EAIS thickness during the LGM by adding new C-14 exposure ages, which generally circumvent the common issue of 10Be and 26Al inheritance in Antarctica. With these new data, the authors identify thicker-than-present LGM ice at a location previously thought to not have been covered by ice at that time. This finding has implications for EAIS volume during the LGM and the EAIS contribution to deglacial sea-level rise. The presence of samples with unsaturated C-14 samples also allows the authors to determine a post-LGM thinning history at this site, which couldn't be done with prior 10Be and 26Al measurements. Overall, I agree with the authors' treatment and interpretation of their data. I really enjoyed reading this manuscript – it is well written and nicely presented. There were a few points, however, that I think could be clarified with relatively minor revisions.

General comments

1. **Interpretation of saturated samples:** The authors spend some time with the question of whether the two saturated samples at/near the nunatak could have been covered by ice at some point during the LGM, which is certainly worthwhile as this determines whether they're able to put an upper bound on ice thickness during the LGM. They conclude that the answer is no, or if they were, it must have been for a short duration or by very thin ice (L217-219; L233-236) and use Figure 3 to support this conclusion. I really struggled, however, to digest Figure 3. There is a lot of information in this figure, so perhaps some of my questions below could be addressed with a slightly longer discussion in the main text and some updates to the figure.
    - The caption says the C-14 concentrations shown result from glacial histories with one episode of burial. I assume then followed by exposure so that the total history is equal to burial date? What are the starting conditions? I assumed saturation?
      The exposure history (what we assume is meant by "total history") would be equal to the difference between the burial date and duration, and the samples are assumed to start with no ^{14}C (simulating lengthy burial during the LGP). We will edit the first line of the caption thus: "Contours show ^{14}C concentrations resulting from glacial histories assuming sample ^{14}C concentrations had entirely decayed away by 50 ka as a result of ice cover during the last glacial period, followed by initial exposure 50 ka and one episode of burial under ice assumed to be sufficiently thick to reduce nuclide production in the sampled surface to negligible rates". Assuming saturation does not noticeably change this figure, due to the short half-life of ^{14}C. We will add the following to the caption to note this: "Assuming saturation 50 ka decreases the minimum burial age for saturation by up to 5 kyr but does not alter our conclusions.".
    - I was confused by the labeling of the black region as "Inconsistent with post-LGM exposure." Isn't the black region just above the 1:1 line for burial start and burial duration? Like, if burial started at 15 ka, and the burial duration was 20 kyr, the site would not only be buried today but also 5 kyr into the future? Since we know the sites aren't covered by ice today, they can't have the exposure histories that fall on that line, or anything in the black area because that requires future burial. In addition, the caption says that the black is scenarios that require burial after 15 ka, but I think there are scenarios that are not in the black area that also require burial after 15 ka? For example, 5 kyr of burial starting at 15 ka, or 10 kyr of burial starting at 20 ka.

We agree with these points, and will change the label to “Impossible histories” and adjust the figure caption accordingly.

- What are the two different greys? Is this the region for burial histories producing unsaturated samples (stated in caption), and if so can the label be moved there?
  We will update this figure to focus more exclusively on the differences between the zones of saturated and unsaturated histories. The region with different gray shadings will thus be one flat color and will be labeled as suggested.
- Is the entire white area the zone of saturation (as stated in the caption) or is it just the area to the left of the 7.3 x 10^5 atoms/g line (where the arrow and label point to)? If I’m reading Figure 2b correctly, it seems like saturation concentrations at 1921 m would span from the 7 x 10^5 atoms/g to the left side of the diagram?
  The white area is the zone of saturation, but we intend to update this figure, and the updated figure will not feature concentration curves, which we felt distracted from the intended conclusions to be drawn from this figure.
- “Only the lesser end of the saturation window is consistent with any significant degree of burial under enough ice to effectively stop production (~10 m)” – I found this sentence confusing, probably in part because I was unsure what the bounds of the saturation window were (see bullet above). Is the “lesser” end just the lowest concentrations that are still considered saturated? If the entire white area produces saturated samples, then it looks to me that there’s a lot of burial allowed. This sentence sort of makes it sound like the ice thickness needed to stop production was explored here, but I don’t think it was? Maybe this just needs explanation in the first sentence of the caption – “…one episode of burial assuming that ice was thick enough (~10 m) that nuclide production in the sampled rock surfaces is negligible on these timescales.”
  We agree and will adjust the figure caption accordingly (see our proposed update to the first line of the caption, above). The figure itself does not explore the ice thickness needed to stop production.
- Is it possible to indicate where the saturated sample concentrations are on the diagram, rather than just referring to them being off the lower left corner of the diagram in the caption? Can the concentrations also be labeled with the sample id?
  While it is possible to include sample concentrations, in response to suggestions from other commenters, we have elected to remove the sample concentrations entirely from the figure. Displaying mean saturation concentrations would require extending the figure significantly due to the asymptotic way that concentrations approach secular equilibrium. Furthermore, we do not think that the specific sample concentrations contribute to our main conclusion of the figure, which is that any saturated sample would be consistent only with long-ago or short burial.
- This figure actually opened a question for me about whether the unsaturated samples had inheritance, which I wasn’t concerned about before seeing this figure. Considering an extreme example, the measured C-14 concentration in sample GR06 (highest unsaturated sample), could be achieved if burial started at 15 ka, with ~6 yr of burial and 8 kyr of exposure, meaning a true deglaciation age of 8 kyr. That scenario seems implausible, but is consistent with the data. On the other hand, as long as burial started before ~30–35ka, the apparent exposure age should be roughly equal to the true deglaciation age. I’m not sure if the authors were trying to make this point, but it came up for me in trying to understand this figure.
  This is true, but as we lack a means of testing this with our dataset and because

we are unaware of any evidence of a glacial thickening ~15 ka elsewhere in this region, we have opted to present only naïve exposure ages for our unsaturated samples. Furthermore, glacial transport often results in erratics that have significantly scattered exposure ages relative to their elevations (as the ^{10}Be and ^{26}Al data here does). Our ^{14}C data, however, shows a mostly consistent trend of decreasing ages with elevation, with the two highest samples lying along a saturation curve.

Stepping back a bit, even if LGM ice-cover were compatible with the saturated C-14 concentrations, the authors' main conclusions still stand. The conclusion that ice was thicker at Nunatak 1921 during the LGM is still true and the unsaturated samples still record the thinning history after 15 ka. So maybe the level of detail in Figure 3, at least as presented, is just overcomplicating things a bit.

1. **MWP-1a discussion:** I actually find the sentences on L285-288 a more impactful way to end the Discussion, given the dataset and conclusions, than the discussion of MWP-1a, which I think could be shortened and simplified. There seems to be a tension between the fact that this chronology shows thinning during MWP-1a and its consistency with the EAIS as a whole being a minor MWP-1a contributor. I agree with the sentence on L290-292 that the work here suggests a modest additional ice volume for MWP-1a. I also agree that the chronology presented here suggests, although does not require, some thinning during MWP-1a (although "likely less than half of post-LGM ice loss" (L293-294) sounds like a lot of ice loss, maybe a nominal thickness loss (<20 m?) is a better reference here). However, this is one nunatak in one part of the EAIS, so I'm not sure it's necessary to extrapolate to the EAIS (L288-290) or Antarctica (L295) as a whole to the extent that's done here.
   We agree that a nominal value for the thickness of ice loss would avoid a potential misunderstanding. But if thinning during MWP-1a involved the ice thinning below the elevation of GR18 and then rethickening, our dataset, which only presents integrated exposure durations, would be able to constrain neither the timing, magnitude, nor duration of any such event. For this reason, we are reluctant to attempt to quantify this statement. We will move the MWP-1a discussion higher in our discussion section to emphasize the discussion of deglaciation and modelling, which we agree is more crucial to our findings.

Minor Comments

1. Figure 2 caption: I wasn't sure exactly what is meant by "error envelope" – is this determined by the typical measurement uncertainty, production rate uncertainty, or both (i.e., above this concentration there is no discernable change in the in the nuclide concentration beyond uncertainty)?
   The error envelope is defined by the instrument uncertainty. Its mean is the calculated secular equilibrium value at a given elevation and latitude assuming no erosion, and its upper and lower bounds are set by the instrumental uncertainty in repeated CRONUS-A measurements from the TUCNL. We will add the following text to the caption: "vertical gray band to right represents the saturation error envelope as derived from the 5.6% uncertainty on repeated CRONUS-A measurements at the TUCNL".
2. L194–195: I might be careful about extrapolating to the covering of nunatak summits throughout the Grove Mountains as a whole, at least at this point in the paper, because I'm guessing neither the elevation difference between each summit and the local ice surface, nor the change in LGM ice thickness, is uniform across the Grove Mountains. I also found the parenthetical statement here (neither

lengthily nor deeply enough…") slightly confusing. Does this mean that if ice did override the summit, it wasn't thick enough to shield the sampled surfaces from the cosmic-ray flux?
Yes, that is our meaning there. We will change the wording to avoid protentional confusion.

3. L201–205: How were the percent thinning calculations made?
By assuming a linear thinning history (see lines 205-207 for further discussion).

4. L274-279: "Deglaciation thus possibly started and likely finished earlier downstream" - Are the Prince Charles Mountains actually downstream of the Grove Mountains (it doesn't look like it to me in Figure 1a)? I was also wondering if it is expected that the glacial history in the Grove Mountains is so different than in the Prince Charles Mountains, and if so, why? It looks like the White data are from Al-26 and Be-10, so is it possible they have some inheritance?
The northeastern Prince Charles are actually downstream of the Grove Mountains (in the sense that a modern flow path from the Grove Mountains to the nearest grounding line passes through them). We would expect thinning in the Prince Charles Mountains to predate that at the Grove Mountains due to the lesser distance from the grounding, meaning it would take more time for the thinning signal to propagate all the way to the Grove Mountains. It is possible that there is some inheritance in the White *et al*. (2011) dataset, but the young (~20 ka) ages and the agreement between the two nuclides give us more confidence in the White *et al*. (2011) dataset than in the hundreds ka ^{10}Be and ^{26}Al ages from our samples.

Line edits

1. L10-11: "380 km inland from the Antarctic coastline" – which sector of Antarctica?
This is in the Lambert Glacier–Amery Ice Shelf sector (drainage basin B-C, in Mouginot et al., 2017), which we will add to the text.

2. L20–21: "above 1912 m asl"? Or, "from 1912 m asl to the nunatak summit at 1921 m asl"? Could this sentence also include an indication of how much thicker these findings require that the ice was during the LGM? Also, there is no mention anywhere in the abstract where Nunatak 1921 is – add reference to Grove mountains somewhere?
We will change this line to read "Samples with ^{14}C concentrations at a secular equilibrium between production and decay (saturation) at and above 1912 m a.s.l. indicate that the summit of Nunatak 1921, a nunatak in the Grove Mountains, was exposed during the LGM, requiring an ice surface ~70 m higher than at present".

3. L59–59: Mention the half-lives of Be-10 and Al-26?
We will add these half-lives to the text.

4. Figure 1 caption: move the sentence now on lines 84–85, which cites White et al. (2011) and Lilly et al. (2010), up to L68–69 to make it clear where this placement of the potential hinge zone comes from?
We will move this sentence.

5. Figure 1c: "interior" and "coastline" are switched.
We will correct these labels.

6. Line 87–88: "testing previously measured samples at a key site in the ice sheet interior" – maybe just state what you are testing and what the key site is?
We will rephrase the sentence to "…by measuring *in-situ* ^{14}C in bedrock and erratic samples previously measured for ^{10}Be and ^{26}Al from the Grove Mountains, a key site in the ice-sheet interior."

7. Section 1.1: Make it clear that Nunatak 1921 is named for the altitude of its peak and also state the ice surface elevation at this site specifically? I think it's mentioned later but it would be helpful to have it here.
   We will add this information in parentheses to the text
8. Table 2 caption (L160): 10^5 is missing when stating blank value.
   We will add this value to the table caption.
9. L167: 10Be and 26Al exposure ages, not concentrations.
   We will make the correction.
10. L182: GR12, not GR21, is out of order?
    We will correct the naming.
11. L202: Add timing of MWP-1a since this is the first mention? Also, should the reference be to figure 2d, not 2b?
    Timing added and figure-reference corrected
12. Line 210: Maybe specify at Nunatak 1921, instead of in the Grove Mountains generally? As consistent with a few comments above, this could be done more often throughout the paper.
    We will change to the text accordingly to specify the nunatak.
13. Line 212: "contrary to previous ice-thickness data" – this isn't really true, it's contrary to previous interpretations of 26Al and 10Be data.
    We will adopt the suggested phrasing.
14. L216: "indicate that ice cover occurred at this site [up to x m above the present ice surface]?"
    We will add this information to the text.
15. L219: "re-saturated during the Holocene" – or during the deglacial / late glacial and Holocene, if it must have been uncovered before GR06?
    We will change the text from "during the Holocene" to "following re-exposure".
16. Figure 3: 14.9 kyr stated for GR06 in caption, but table and text say 14.6 kyr. Also, the caption says GR21 = 7 x 10^5 atoms/g, which I don't think is right?
    We will revise this figure, and remove references to individual sample concentrations from its caption.
17. L247: Rather than the coast being representative of the interior, could this be simplified to "the zone of thicker-than-present LGM ice extends further inland than previously thought"?
    We will simplify the wording based on this suggestion: "Our new chronology indicates that the zone of thicker-than-present LGM ice extended further inland than was previously thought".

Citation: https://doi.org/10.5194/egusphere-2024-2674-RC2